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APPARATUS FOR HEATING GLASS SUBSTRATE

[Abstract]

PURPOSE: To provide a heater capable of uniformly heating the entire surface of glass substrates and acting the pressurization of these glass substrates as uniformly distributed load on the substrates as well.

CONSTITUTION: This heater has one stationary surface plate 2 which holds two sheets one set of the aligned and temporarily fixed glass substrates a, b and a facing movable surface plate 3 which can vary the distance from the plate 2 and is pressurized by a pressurizing means 5. The stationary plate 2 and the moving plate 3 are bored with recessed parts 7, 14 exclusive of their

circumferential edges on the surfaces respectively facing the glass substrates a, b and the openings of the recessed parts 7, 14 are closed by thin sheets 8, 15. In addition, the circumferences of the sheets 8, 15 are fixed to the circumferential edges and heating elements 9, 16 are mounted at the front surfaces or rear surfaces of the thin sheets 8, 15. Further, the respective recessed parts of the stationary plate 2 and the moving platen 3 are connected and equipped with air supplying means.

[Claims]

1. An apparatus for heating a glass substrate for a liquid crystal display device capable of hardening a sealant formed of a thermal resin and interposed between two glass substrates by heating and pressurizing, the apparatus characterized in that a fixed plate and a movable plate facing the fixed plate, pressurized by a pressurizing unit, and movable to widen or narrow a gap between the fixed plate are arranged to align and bond two glass substrates to each other, the fixed plate and the movable plate are respectively provided with a concave portion formed by puncturing with remaining a peripheral edge thereof at surfaces thereof facing the glass substrates, a passage of the concave portion is closed by a thin plate, an edge of the thin plate is fixed to the peripheral edge, a heater is installed at an outer surface or an inner surface of the thin plate, and an air supplying unit is connected to each concave portion of the fixed plate and the movable plate.

2. The apparatus of claim 1, wherein the heater is a plane heater that a conductive member is installed at a thin plate formed of an insulating material.

[Title of the Invention]

APPARATUS FOR HEATING GLASS SUBSTRATE

[Detailed Description of the Invention]

The present invention relates to an apparatus for heating a glass substrate, and more particularly, to an apparatus for heating a glass substrate capable of bonding upper and lower glass substrates having a sealant therebetween by a mark alignment and capable of heating the glass substrates by pressurizing the sealant up to a certain gap between the two glass substrates.

[Field of the Invention]

[Description of the Prior Art]

In a liquid crystal display (LCD) device, two glass substrates on which a transparent conductive electrode is coated has a certain gap therebetween by using a spacer of several μm, and a liquid crystal is injected into an inner space formed by a sealant thereby bonding the two glass substrates with order by an aligning mark.

A spacer is spread on one of the two glass substrates and a sealant formed of a thermal resin is mounted at an inner surface of another glass substrate facing the one glass substrate, thereby bonding the upper and lower glass substrates by a bonding device with a mark alignment. Also, the upper and lower glass substrates are pre-fixed not to be separated from each other. The pre-fixed two glass substrates are pressurized and heated, and the sealant is pressurized until the gap between the two substrates corresponds to a particle diameter of the spacer thereby to be hardened.

In the prior method, the sealant is hardened by laminating plural pairs of two glass substrates that have been bonded to each other, by setting the glass substrates into a jig by pressurization, and by putting the substrates into a furnace.

[Problems to be Solved by the Invention]

However, in case of setting the pair of glass substrates into the zig and heating the glass substrates in a furnace, a temperance difference is generated between a center portion and a peripheral portion of the glass substrates and the aligned glass substrates are horizontally moved by a difference of a heat expansion. To prevent this, a heating time and a heating temperature are adjusted. However, in that case, an operation characteristic is lowered and a productivity is lowered.

The sealant between the pre-fixed pair of glass substrates is solved and hardened by heating the glass substrates. Also, at the time of heating the glass substrates, the glass substrates are pressurized so that the gap therebetween corresponds to the particle diameter of the spacer. However, the pressurization is not uniformly applied on the entire glass substrates thereby to have a difficulty in obtaining a constant gap between the two glass substrates.

The present invention is to provide an apparatus for heating a glass substrate capable of uniformly pressurizing a glass substrate and uniformly heating an entire surface of the glass substrate.

[Means for Solving the Problem]

The present invention relates to an apparatus for heating a glass substrate for a liquid crystal display device capable of hardening a sealant formed of a thermal resin and interposed between two glass substrates by heating and pressurizing, the apparatus characterized in that a fixed plate and a movable plate facing the fixed plate, pressurized by a pressurizing unit, and movable to widen or narrow a gap between the fixed plate are arranged to align and bond two glass substrates to each other, the fixed plate and the movable plate are respectively provided with a concave portion formed by puncturing with remaining a peripheral edge thereof at surfaces thereof facing the glass substrates, a passage of the concave portion is closed by a thin plate, an edge of the thin plate is fixed to the peripheral edge, a heater is installed at an outer surface or an inner surface of the thin plate, and an air supplying unit is connected to each concave portion of the fixed plate and the movable plate. The heater is a plane heater that a conductive member is installed at a thin plate formed of an insulating material.

The thin plate for closing the concave portions of the fixed plate and the movable plate includes a metal thin plate (for example, a stainless thin plate) having a thickness corresponding to 30μm to 200μm, a stainless thin plate having a thickness of 100μm, a synthetic resin thin plate having a high elasticity (for example, polycarbonate thin plate), etc. Also, the air supplying unit is connected to a side surface of the peripheral edge of the fixed plate and the movable plate by being connected to the inside of the concave portion. The thin plate for closing the passage of the concave portion by air-stream rather than the air supplying unit is expanded from the inside by

pressurization, and the air supplying unit serves as a buffer at the time of pressurizing the glass substrates. As the heating apparatus according to the present invention, both a vertical type heating apparatus for vertically moving the base plate by supporting the glass substrate in a horizontal direction and a horizontal type heating apparatus for horizontally moving the base plate by supporting the glass substrate in a vertical direction are possible. In case of the horizontal type, a vacuum absorbing unit for supporting the glass substrate in a vertical state is installed on at least one base plate.

In the present invention, the fixed plate and the movable plate of the heating apparatus are provided with a concave portion formed by puncturing at a body of the base plate with remaining a peripheral edge thereof, and a passage of the concave portion is closed by the thin plate. Also, since the edge of the thin plate is fixed to the peripheral edge and the heater is installed at the outer surface or the inner surface of the thin plate, the entire surfaces of the two glass substrates are uniformly heated thereby to prevent a difference of a heat expansion on the glass substrates. Air is supplied to inside of the concave portions of the two plates by the air supplying unit thereby to expand the thin plates. Accordingly, the two plates have a shape corresponding to a leather of a drum, and thereby the base plates have a buffering function. The glass substrates are pressurized through the buffering function of the base plates, thereby applying a uniform load onto the glass substrate. The load is applied onto the glass substrate only in a perpendicular direction, thereby having a uniform gap between the two glass substrates.

Hereinafter, a preferred embodiment of the present invention will be explained with reference to the attached drawings. The apparatus for heating a glass substrate A comprises a mechanical frame 1, a fixed plate 2 fixed at a lower portion inside the mechanical frame 1, a movable plate 3 arranged at an upper side of the fixed plate 2, a driving unit 4 for moving the movable plate 3 up and down, and a pressurizing unit 5 for pressurizing the movable plate 3 that has been lowered up to a certain position to the fixed plate 2 and pressurizing the bonded and pre-fixed glass substrates a and b positioned on the fixed plate 2. The apparatus is constructed as a vertical type.

In the fixed plate 2 fixed at a lower portion inside the mechanical frame 1, a concave portion 7 having a certain depth and a plane of a square shape is formed by puncturing at a body of the base plate with remaining a peripheral edge 6, an opening of the concave portion 7 is closed by a thin plate 8, and an edge of the thin plate 8 is fixed to the peripheral edge 6. Also, a heater 9 is attached to a surface of the thin plate 8, and a hole 10 connected to the inside of the concave portion 7 is installed at a side surface of the peripheral edge 6 of the body of the base plate. The hole 10 is connected to an air supplying unit, and supplies air into the hermetic concave portion 7 thereby to expand the thin plate 8.

The thin plate 8 for closing the concave portion 7 is formed of a stainless material having a thickness corresponding to 30μ~200μ, preferably 100μ, and has a nearly same shape as the fixed plate 2. The edge of the thin plate 8 is fixed to a peripheral edge 6 of the body of the base plate by a welding material or an adhesive material. The heater 9 fixed onto the surface of the thin plate 8 is formed as a plane heater that a conductive member 12

such as a carbon is printed on a thin plate 11 formed of an insulating material such as a ceramic, quartz, synthetic resin, etc. (plate thickness: 100μ~300μ). Accordingly, as power is applied to the conductive member 12, the heater 9 generates heat.

In the movable plate 3 arranged above the fixed plate 2 to be moved up and down in a perpendicular direction, a concave portion 14 having a certain depth and a plane of a square shape is formed by puncturing at a body of the base plate with remaining a peripheral edge 13, an opening of the concave portion 14 is closed by a thin plate 15, and an edge of the thin plate 15 is fixed to the peripheral edge 13. Also, a heater 16 is fixed onto a surface of the thin plate 15, and a hole 17 connected to the inside of the concave portion 14 is installed at a side surface of the peripheral edge 13 of the body of the base plate. The hole 17 is connected to an air supplying unit, and supplies air into the hermetic concave portion 14 thereby to expand the thin plate 15.

The thin plate 15 for closing the concave portion 14 is formed of a stainless material having a thickness corresponding to 30μ~200μ, preferably 100μ, and has a nearly same shape as the movable plate 3. The edge of the thin plate 15 is fixed to a peripheral edge 13 of the body of the base plate by a welding material or an adhesive material. The heater 16 fixed onto the surface of the thin plate 15 is formed as a plane heater that a conductive member 19 such as a carbon is printed on a thin plate 18 formed of an insulating material such as a ceramic, quartz, synthetic resin, etc. (plate thickness: 100μ~300μ). Accordingly, as power is applied to the conductive member 19, the heater 16 generates heat. Also, the heater 9 installed at the

fixed plate 2 and the heater 16 installed at the movable plate 3 are constructed as a heater that the conductive member is installed on the thin plate so as to uniformly heat the entire surface of the glass substrate.

The driving unit 4 for moving the movable plate 3 up and down comprises a guide rail 20 fixed at a side surface of the mechanical frame 1 in a perpendicular direction, a supporting frame 21 having one end engaged to the guide rail 20 and moved up and down, a suspension member 22 engaged to the supporting frame 21 for moving the supporting frame 21 up and down, and a winding unit 23 for releasing or winding up the suspension member 22. The movable plate 3 is fixed to a lower surface of the supporting frame 21 under a state that the heater 16 is towards a lower direction. When the suspension member 22 is released down by driving the winding unit 23, the supporting frame 21 is lowered along the guide rail 20 under an engaged state to the suspension member 22. Then, the supporting frame 21 is in contact with the two glass substrates positioned on the fixed plate 2, and the engagement of the supporting frame 21 to the suspension member 22 is released. Accordingly, the movable plate 3 is positioned on the glass substrates in a free state.

The pressurizing unit 5 for pressurizing the movable plate 3 positioned on the glass substrates onto the fixed plate 2 is constructed by an air cylinder 24 suspended at an upper side of the mechanical frame 1, and pressurizes the movable plate 3 under a state that the supporting frame 21 is interposed therebetween.

A heat insulator 25 is installed at an opposite side to the heaters 9 and 16 installed at the fixed plate 2 and the movable plate 3 so that heat

generated from the heaters 9 and 16 can be applied onto the glass substrate. The heat insulator 25 is fixed to rear portions of the thin plates 8 and 15. In case that the heaters 9 and 16 are fixed to the rear portions of the thin plates 8 and 15, the heat insulator is bonded to the heaters 9 and 16.

The two sheets of glass substrate a and b supplied to the heating apparatus may be bonded to each other by a bonding device with a mark alignment, and a spacer 26 of several μm is inserted between the glass substrates. Also, a sealant 27 formed of a thermal resin is mounted at a peripheral portion of the glass substrates, so that the two glass substrates a and b are pressurized to have a gap therebetween corresponding to approximately 15 μm and pre-fixed. Then, the two glass substrates are positioned on the fixed plate 2 of the heating apparatus, and the movable plate 3 is lowered by operating the driving unit 4. Also, the heater 16 of the movable plate 3 is in contact with the surface of the glass substrate (a) and the suspension member 22 is separated from the supporting frame 21 by operating the driving unit 4, thereby positioning the movable plate 3 on the glass substrate (a) in a free state. Then, the movable plate 3 is pressed down by operating the pressurizing unit 5, thereby pressurizing the two glass substrates a and b. At the same time, the heaters 9 and 16 are conducted, and the sealant 27 is pressed until the gap between the glass substrates corresponds to the diameter of the spacer 26 and is heated thereby to be hardened. The gap between the glass substrates a and b is set to be approximately 5μm. The sealant is heated for approximately 10 minutes in a temperature range corresponding to approximately 140°~180°. Since the fixed plate 2 and the movable plate 3 have a buffering structure that the

passage of the concave portion is closed by the thin plate and air is injected into the concave portion and sealed, the glass substrates a and b are pressurized by an air bag. As the result, a uniform load is applied onto the glass substrates and the sealant 27 is uniformly pressurized, thereby maintaining the gap between the glass substrates a and b constantly and thus completing a product of a high quality. In the present invention, one vertical type heating apparatus is installed. However, it is possible to install a horizontal type heating apparatus. Also, since it takes approximately 10 minutes to heat the sealant, a plurality of heating apparatuses (for example, 10 apparatuses) may be arranged as a ring shape and are alternately operated by a chain, etc. for the enhanced productivity.

[Effect of the Invention]

In the apparatus for heating a glass substrate for a liquid crystal display device according to the present invention, as shown in the claim 1, the glass substrates are pressurized by the buffering structure of the fixed plate and the movable plate and thereby a uniform load is applied onto the entire glass substrates only in a perpendicular direction. In order to uniformly heat the glass substrates, the gap between the upper and lower glass substrates is constantly maintained by preventing the upper and lower glass substrates from being mis-aligned. Also, since the glass substrates are heated by the heaters provided at the base plate, a stable heating is performed thereby to reduce the heating time.

Also, since the heater is constructed as a plane heater as shown in the claim 2, the entire surface of the glass substrate can be uniformly heated

thereby to prevent the mis-alignment between the upper and lower glass substrates and thus to perform a stable process.

[Description of Drawings]

FIGURE 1 is a partially-cut front view showing one embodiment of an apparatus for heating a glass substrate according to the present invention;

FIGURE 2 is an enlarged section view showing a part surrounded by a circle in FIGURE 1;

FIGURE 3 is an enlarged view showing a lower part of the line (3)-(3) in FIGURE 1;

FIGURE 4 is a partially-cut front view showing a state that a movable plate is lowered to be positioned on a glass substrate;

FIGURE 5 is a partially-cut front view showing the same part as that of FIGURE 4 under a state that a pressurizing unit is operated; and

FIGURE 6 is an enlarged section view showing another embodiment of a base plate.

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